

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

EMG4076 – ELECTROMAGNETIC INTERFERENCE (TE/RE)

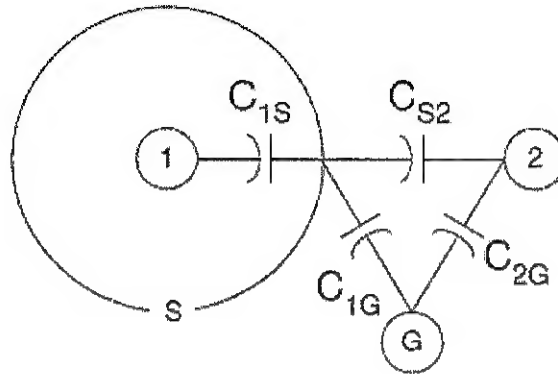
22 OCTOBER 2018
9.00 A.M. – 11.00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages with 4 Questions only.
2. Attempt all **FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

- (a) Consider three parallel wires, two are signal leads (lead-1 and lead-2) and the third is a common signal-return lead (lead-G). Lead-1 is shielded with a copper sleeve as shown in **Figure Q1a**.

**Figure Q1a**

- (i) State the effect on the capacitive coupling between lead-1 and lead-2 if the shield is not grounded. [2 marks]
- (ii) If the shield is grounded with a pigtail-lead, draw the equivalent circuit for the capacitive coupling. [4 marks]
- (iii) By analyzing the equivalent circuit in (a)(ii), assuming the source resistance of the signal source of lead-1 is negligible, find the expression for the noise voltage V_N , on lead-2. Include the effect of pigtail-lead inductance. [13 marks]
- (b) With the aid of diagram, explain the implementation of balance circuit in reducing the noise voltage due to inductive coupling. [6 marks]

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Question 2

- (a) With the aid of diagrams, explain about the 'hybrid ground' system.

[6 marks]

- (b) **Figure Q2b** shows a poorly designed ground layout for a motor subsystem.

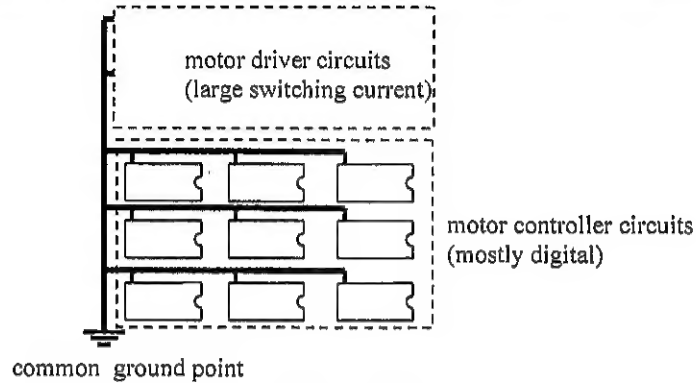


Figure Q2b

- (i) Discuss two potential problems with such a ground layout.

[4 marks]

- (ii) Suggest a better ground layout for the subsystem.

[4 marks]

- (c) For the circuit in **Figure Q2c**, find the expression for the ground noise coupled into the differential amplifier, V_N . Calculate the relative magnitude (in dB) of the V_N with respect to the signal voltage V_S when R_{in} is

- (i) $100\text{ k}\Omega$,
 (ii) $1\text{ M}\Omega$,
 (iii) $10\text{ M}\Omega$.

[11 marks]

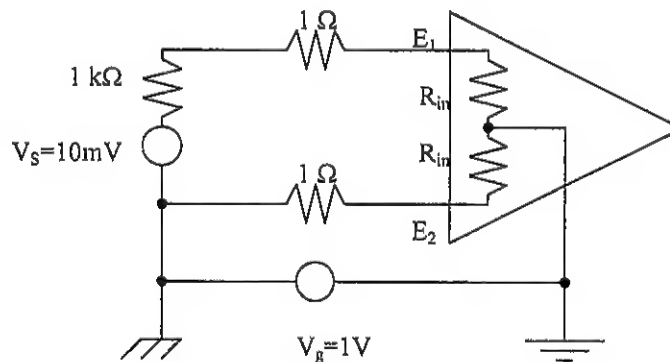


Figure Q2c

Continued...

Question 3

- (a) Wire passing through into a shielded enclosure can conduct noise current through the hole and then re-radiates the wave into the air space. Propose five (5) treatments to reduce the electromagnetic interference (EMI) for LOW frequency lead that is passing through a hole into a shielded enclosure.

[10 marks]

- (b) A panel, 12 cm wide and 36 cm high, is attached to a cabinet by 24 equally spaced screws around its perimeter, including one screw at each corner. The equipment in the cabinet generates a 150 MHz signal. Assume all the phases of the signals from all slots are equal and neglect any interference to aperture currents from adjacent slots,

- (i) Calculate the attenuation of this signal when it passes through the resulting slots and reach the receiving antenna 30 m away from the shield.

[6 marks]

[Hint: Attenuation A due to a slot of length l at a distance r from the slot is approximately $A = 73 - 132.45 \frac{l}{\lambda} + 20 \log \frac{r}{\lambda}$ dB where λ is the wavelength of the signal.

- (ii) If 8 equally spaced screws are used, including one at each corner, how much is the attenuation when the signal pass through the resulting slots to reach the receiving antenna in (b)(i)?

[5 marks]

- (iii) From your answer in (b)(i) and (b)(ii), which case is more effective in reducing the electromagnetic interference (EMI). Justify your answer.

[4 marks]

Continued...

Question 4

- (a) Briefly describe the roles played by the Federal Communication Commission (FCC), the European Committee for Electrotechnical Standardization (CENELEC) and the International Electrotechnical Commission (IEC) in defining EMC standards. [9 marks]
- (b) The FCC radiated emission limits for Class B digital devices are shown in **Table Q4b**. Determine those levels at 10 meters for Class B digital devices in dB μ V/m. [6 marks]

Table Q4b

Frequency	Class-B limits at 3m
30 - 88 MHz	100 μ V/m
88 - 216 MHz	150 μ V/m
216-960 MHz	200 μ V/m
Above 960 MHz	500 μ V/m

- (c) Sketch the setup of test facility for conducted emission measurements. Explain two (2) main functions of Line Impedance Stabilization Network (LISN) during the test. [6+4 marks]

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